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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,915	06/25/2003	Kazuhiko Yamamoto	60188-606	1774

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Washington, DC 20005-3096

EXAMINER

NADAV, ORI

ART UNIT	PAPER NUMBER
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2811

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/22/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/602,915

Applicant(s)

YAMAMOTO, KAZUHIKO

Examiner

Ori Nadav

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3,4,23-27 and 31-35 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3,4,23-27 and 31-35 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

Claim 4 is objected to because of the following informalities: The phrase "the interface" should read "an interface". Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 4 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claimed limitations of "the interface between the silicon nitride film and the zirconium oxide film is formed of a zirconium silicate film", as recited in claim 4, are unclear as to how an interface (that is, a common boundary) exists between the silicon nitride film and the zirconium oxide film if a zirconium silicate film is formed there-between.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 23-24, 26-27, 31 and 33-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaushik (6,448,192) in view of Ma et al. (6,297,539).

Kaushik teaches in figure 6 and related text a semiconductor device comprising a gate insulating film 50 having a multilayer structure including a zirconium oxide film and a high dielectric constant film which is a hafnium oxide film or a hafnium aluminate film zirconium (column 3, lines 40-42),

wherein a silicon oxide film is formed under the zirconium oxide film

Kaushik does not explicitly teach forming the hafnium oxide film on the zirconium oxide film and forming a silicon nitride.

Kaushik teaches in column 3, lines 40-42 using a high K material comprises combinations of a zirconium oxide film, a hafnium oxide film and aluminum oxide. This means, an artisan forming the device would optimize the characteristics of the device by experimentally forming the hafnium oxide film on the zirconium oxide film and by forming the hafnium oxide film under the zirconium oxide film.

Ma et al. teach in figures 2 and 3 and related text forming a silicon nitride 62 under the zirconium oxide film.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form the hafnium oxide film on the zirconium oxide film and to use silicon nitride, in Kaushik's device in order to improve the gate dielectric characteristics of the device, and in order to increase the permittivity and to reduce the size of the device, respectively.

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Regarding claims 24, 27, 31 and 34, prior art teaches comprising a gate electrode on the gate insulating film and an insulating sidewall spacer 70 formed to cover the side faces of the gate electrode.

Regarding claims 23, 26, 33 and 35, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a silicon nitride film thickness of 1 nm or less and a gate electrode of thickness between 30-100 nm, wherein the high dielectric constant film substantially directly contacts the top surface of the zirconium oxide film in prior art in order to improve the device characteristics.

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaushik and Ma et al., as applied to claim 1 above, and further in view of Yang et al. (6,451,647).

Kaushik and Ma et al. teach substantially the entire claimed structure, as applied to claim 1 above, except a high dielectric constant film contains nitrogen. Yang et al. teach the high dielectric constant film (hafnium silicate layer) contains nitrogen (column 5, lines 19-23). It would have been obvious to one having ordinary skill in the art at the time the invention was made to incorporate the teaching of Yang et al. in prior art's device in order to provide better protection to the gate by increasing the dielectric constant of the high dielectric constant film.

Claim 4, as best understood, is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaushik and Ma et al., as applied to claim 1 above, and further in view of Lee et al. (6,844,604).

Kaushik and Ma et al. teach substantially the entire claimed structure, as applied to claim 1 above, except a gate insulating film includes a zirconium silicate film formed under the zirconium oxide film.

Lee et al. teach a gate insulating film includes a zirconium silicate film 12 formed under the zirconium oxide film. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a gate insulating film includes a zirconium silicate film formed under the zirconium oxide film in prior art's device in order to improve the device characteristics.

Claims 25 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaushik and Ma et al., as applied to claim 1 above, and further in view of Price et al. (4,605,947).

Kaushik and Ma et al. teach substantially the entire claimed structure, as applied to claims 1 and 24 above, except a gate electrode is a titanium nitride. Price et al. teach a gate electrode 70 is a titanium nitride. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use a gate electrode being a titanium nitride in prior art's device in order to improve the device characteristics by a well known gate material.

Response to Arguments

Applicant's arguments with respect to claims 1, 3, 4, 23-27 and 31-35 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ori Nadav whose telephone number is 571-272-1660.

The examiner can normally be reached between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richard Elms can be reached on 571-272-1869. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



O.N.
1/15/07

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